The Pleistocene laminated sediments of Victoria Cave, North Yorkshire, UK: characteristics, age and significance

The new species is known from a dentary that preserves the p4 and all of the molars. It is broken behind the m3. In front of the p4, four alveoles are preserved. The foremost of these is tiny and evidently belongs to an incisor. It contains part of the root. The alveole behind this is very large. It has a sub-elliptical shape with the length axis in the direction of the mandible. This is considered to be the alveole of the canine. The last two alveoles are smaller, with the front one being larger than the other, but still clearly smaller than the canine alveole. The alveoles stand in line and are interpreted as the alveoles of the p2 and a relatively small p3.

Merely by its size, it is clear that the new Jamaican bat cannot be assigned to any known species. The largest New World *Myotis* is M. vivesi (Blood & Clark); the largest length of the mandibular tooth row of M. vivesi makes it clear that the Jamaican species was larger still. *Myotis* is not otherwise known from the Greater Antilles, and it is hardly surprising that it represent a new and endemic species. The large size of *Myotis* sp. nov. is probably related to the ancestral *Myotis* finding its niche in the varied bat fauna of Jamaica.

Myotis is considered to have only limited dispersal ability, but long distance dispersal is a matter of chance. Chances for bats to reach remote islands such as Hawai'i are infinitely small, yet these islands were colonized on two separate occasions. The ancestor of *Myotis* sp. nov. presumably reached Jamaica during such a chance event. As Jamaica became subaerial during the Miocene, the available time window is quite large.

Caves and karst of the Yorkshire Dales (KEYNOTE)

Tony Waltham
[tony@geophotos.co.uk]

Stretching over the last seven years, compilation of the two volumes of the BCRA's new book has given the editors an unusually broad and deep overview of the caves and karst of the Yorkshire Dales. The necessary joined-up thinking has improved our understanding of the Dales, but has also revealed how much we still don't know.

Some very large chunks of passage await exploration, notably behind Black Keld. Beneath Gragareth, Duke Street and Eastern Front are just fragments of an ancient trunk route that carried the drainage from entire dales, but we don't know where from or to or even in which direction for much of Quaternary time. Major inlets and outlets are unknown at Gaping Gill, and include questions about deep phreatic lifts. We still cannot explain the evolution, and even the locations, of the great phreatic ramps in Sleets Gill Cave and elsewhere.

Debate continues over the earliest stages of cave development. Shale beds, bedding planes and inception horizons are all variations on a theme, but it will take a lot of detailed underground mapping to resolve which are the most important of the guiding geological features. And then there is the role of hypogene cave development, which is conspicuous in the great maze caves within the Yoredale limestones. But we don't know its extent within the Great Scar Limestone before the allogenic streams invaded from the shale cover. Trunk passages exist now beneath the shale and grit cover in Nidderdale, and did exist beneath the same cover in Gragareth, but we have to question how far they reached beneath the flanks of ancestral Ingleborough.

Understanding the chronology of the Dales caves and karst took a leap forward with uranium-thorium dating of stalagmites, but many caves evolved before a time that is the limit of this technique. We await the opportunity and budget to determine earlier ages by aluminium-beryllium dating. And then we can look further into the state of the caves during the Quaternary glaciations. Sub-glacial drainage, ice plugs and pro-glacial lakes are still open to debate, and we don't even know exactly how Malham Cove was formed.

These are just some of the questions that remain, and answers are not easy, but these are the challenges for the next generation of cavers.

Yorkshire Dales cave climate monitoring (POSTER)

Jo White

Department of Earth and Planetary Sciences, Birkbeck, University of London, Malet Street, London, WC1E 7HX, UK.
[jo.white@hotmail.co.uk]

Birkbeck University and University College London are currently undertaking research into rapid climate events in the early Holocene using speleothem samples from Yorkshire Dales caves.

This study aims to provide and analyse current cave climate data as a background to this work. A variety of methods have been used including temperature and drip rate loggers situated in the caves along with hand held temperature, CO_2 and relative humidity readings. In addition to this, cave and surface water samples have been collected for isotope analysis. This study will be one of the longest-running cave climate monitoring studies to date, and we hope that this will provide an interesting insight into both current cave climates and palaeoclimate.

The project began in August 2016, and this poster provides the findings one year in, along with future progressions and objectives for the project.

The Pleistocene laminated sediments of Victoria Cave, North Yorkshire, UK: characteristics, age and significance (ORAL)

Tom C Lord [1], Adrian P Palmer [2], Matt W Telfer [3], Phillip J Murphy [4], Mark Lewis [5], Peter Wilson [6]

[1] Langcliffe, Settle, North Yorkshire, BD24 9PZ, UK, and
Department of Archaeology, University of York, King's Manor, York, YO1 7EP, UK.
[2] Centre for Quaternary Research, Department of Geography, Royal Holloway, University of London, Egham, Surrey, TW20 0EX, UK.
[3] School of Geography, Earth and Environmental Sciences, University of Plymouth, Plymouth, PL4 8AA, UK.
[4] School of Earth and Environment, University of Leeds, Leeds, LS2 9JT, UK.
[5] Calleva Project, Department of Earth Sciences, Natural History Museum, London, SW7 5BD, UK.
[6] Environmental Sciences Research Institute, School of Geography and Environmental Sciences, Ulster University, Coleraine, Co. Londonderry, BT52 1SA, UK.

Victoria Cave (National Grid Reference: SD 838650) is part of a relict phreatic cave system that opens to the surface at 440m above sea level in the face of Langcliffe Scar on the eastern side of the Ribble valley, ~2km northeast of Settle, North Yorkshire. The cave has developed in massive, gently-dipping beds of the Gordale Limestone Member of the Lower Carboniferous

(Asbian) Malham Formation. The cave, ~50m in length, is probably a glacially-truncated remnant of a formerly more extensive passage.

The cave contains several calcite flowstones, between which laminated silts and clays are present. Thermal Ionization Mass Spectrometer U/Th (TIMS) dating indicates that flowstone formation occurred in each of the interglacial stages MIS 13, 11, 9, 7, 5 and 1. The four laminated units have been assigned to cold stages MIS 12, MIS 10, MIS 6 and MIS 2 (note that there is no laminated unit equivalent to MIS 8), but they have not been dated directly, and there is limited information concerning their sedimentary characteristics. These units are present in the deep sections that were left open at the cessation of the large-scale excavations carried out by the Settle Cave Exploration Committee during the 1870s. They are inherently fragile, and where exposed they re susceptible to damage from visitor egress and rabbit burrowing.

As part of a conservation initiative by the Yorkshire Dales National Park Authority we focussed our investigations on the deep mid-cave section where the exposures are most at risk. This part of the cave contains a stack of three discrete laminated units formerly assigned to MIS12, MIS 10 and MIS 2. The uppermost unit is overlain by an AMS radiocarbon dated Late Glacial Interstadial bone bed. We sampled the laminated units for mineralogical evaluation using X-ray diffraction, micromorphology using thin sections, pollen investigation, and optically stimulated luminescence (OSL) dating.

The laminated units have remarkably consistent mineralogy with samples consisting principally of quartz and calcite with minor amounts of kaolinite, chlorite and muscovite. These results suggest the sediments consist of grains derived from the local Carboniferous limestones, sandstones of the Yoredale Series and/or the Millstone Grit. The presence of chlorite in all samples suggests that the Lower Palaeozoic rocks which crop out as an inlier in the Ribble Valley north of Victoria Cave were exposed prior to MIS12 when the Light Brown Sandy Laminated Clay was deposited. This supports previous geomorphological reconstructions of the area that indicate the Lower Palaeozoic inlier up-ice from Victoria Cave was exposed by ~500 ka BP.

The micromorphology demonstrates a broadly consistent evolution of the laminated units during the different cold stages. All the evidence indicates sediment deposition into standing water, and it is tempting to regard the silt-clay couplets as varves associated with glaciolacustrine environments. In this case a cave lake seems to have developed, perhaps because of an ice/sediment dam across the entrance.

Slides prepared for pollen investigation revealed only a mineral component, and this was true of those samples drawn from the lowermost and uppermost levels within the laminated units. These levels might have been expected to yield pollen representing the decline and initiation, respectively, of regional plant assemblages associated with transitional environmental conditions. (non-glacial – glacial, glacial – non-glacial). The total absence of pollen is regarded as negative evidence for the laminated units having accumulated under full glacial conditions.

A preliminary OSL date of ~65 ka was obtained from the upper part of the youngest laminated unit previously assigned to MIS 2. If this age is correct it indicates an MIS 4 rather than MIS 2 age for the unit. Two issues arise from this date: (1) where are the MIS 2 sediments? (2) did northern Britain have extensive glacial ice cover during MIS 4? This latter point is supported by offshore sediments in the North Sea Basin and in the North Atlantic to the west of Scotland/Ireland. The upper laminated unit of Victoria Cave may represent terrestrial evidence for this glaciation.

The White Rabbit Marble Cave, Monashee Mountains, BC, Canada: a remarkable cave system in stripe karst (ORAL)

Chas Yonge [1]

[1] Yonge Cave & Karst Consulting, 1009 Larch Place, Canmore AB T1W 1S7, Canada
[cjyonge@telus.net]

The White Rabbit System is an extensive marble cave found in the Shuswap Metamorphic Complex lying within in the Monashee Mountains, west of the Main Ranges in Canada. Other significant marble caves in this belt are Nakimu, the Tupper–Raspberry System, and Cody.

Whereas the oldest rocks at White Rabbit are within the Precambrian, between 2.5 and 1.8 billion years, metamorphism occurred later – possibly in the Cambrian to early Palaeozoic around 500 million years ago – which generated an overfolded cave-bearing marble. The cave is a classic example of marble stripe karst, sandwiched between schists and quartzites of relatively low dip. This geological structure has favoured the development of a relatively long cave system – currently around 5km with considerable hydrological depth potential (>1,000m). This presentation explores the stripe karst speleogenesis of the cave system, especially in respect of its glacial karst in an alpine setting.

The hydrogeology of the Banff Hot Springs, Banff National Park, Canada: a karst perspective (POSTER)

Chas Yonge [1], Dave Lowe [2]

[1] Yonge Cave & Karst Consulting, 1009 Larch Place, Canmore AB T1W 1S7, Canada.
[cjyonge@telus.net]

[2] BCRA; Editor of *Cave and Karst Science.*

The Banff Hot Springs at the Cave and Basin in Banff is the historical focal point of Banff National Park. These carbonate springs lie within a 10-km section of the 300km-long Sulphur Mountain Thrust (SMT) where it meets the topographically low-lying Bow Valley. The maximum depth of flow for the thermal water has been calculated to be around 3.2km with discharge temperatures up to 67°C. Hot spring discharge, via the SMT, appears to have targeted the low-lying antecedent Bow Valley, the latter having commenced its incision with the Rocky Mountain Uplift some 85 Ma ago. More recently, in the Holocene, tufa deposits have formed. The cessation of growth of these tufa deposits from 5.3–3.3 ka has been explained in terms of climate change, but we suggest that Holocene post-glacial karstification of the system has allowed shallow groundwater to dilute the supersaturated underflowing thermal water thereby preventing external calcite precipitation. (We also discuss the speleogenesis of caves within the tufa.) Further, we calculate that the hottest spring temperatures are associated with recharge locations much more distant than thought previously. We apply a quasi-Darcian flow model, usually applied to epigenetic cave systems, to those in thermal hypogene carbonates, finding that distal recharge may be ~95km away. In support of our assumptions, we compare the Banff Hot Spring karstification to a local relict cave system also developed along a thrust fault.

Next BCRA Cave and Karst Science Symposium: Saturday 13th October 2018, hosted by Dr David Richards, University of Bristol.